Arkansas River Fleet

Murray Link Pin Removal/Replacement

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BUILDING STRONG®

MURRAY, LOCK & DAM 7
LITTLE ROCK, ARKANSAS

Background Condition

Based on a miter gate failure at Greenup Lock on the Ohio River, SWD mandated a nondestructive analysis (Ultrasonic Testing or UT) of all of the miter gate upper anchorage assemblies for the MKARNS Locks. This nondestructive testing produced “possible crack indication” in one of the three link pins at the downstream river wall miter gate at Murray lock. To complete this analysis, the link pin must be removed (without damage to the “possible crack” area) so it can be destructively tested to determine if a crack actually exists

Utilizing UT shots by TVA Technicians, certain anomalies perceived as cracks were observed in the link pin in the upper miter gate anchorage assembly in the downstream river wall gate at Murray lock and Dam.

Subsequently, removal and replacement of the pin was mandated.

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Removal/Replacement Procedure

- Issue Navigation Notice
- Contract for diamond saw cutting, flange removal, UT testing, etc.
- Design and fabricate bracing (3-directions) and jacking frame
- Procure and/or prepare equipment
- Chamfer new pin and UT pin after modification to verify for use
- Drill pilot hole into existing pin
- Remove top flange, cut groove, and weld twisting bar to head
- Install bracing to prevent movement to anchorage assembly
- Apply twisting pressure via twisting bar with hydraulic jacks
- Fill lock chamber
- Install jacking frames and weld contact blocks
- Cool new pin with dry ice and heat link with welding blanket heater
- Use hydraulic jack to press pin out with new pin as replacement
- If no movement, use diamond saw to remove segment of pin

Removal & Replacement of a "Link Pin" (revision-2)
Miter Gate, Downstream, Riverwall, Upper Anchorage Assembly
Murray L&D on MKARNS

1	**Background Information:** Following the catastrophic miter gate anchorage failure (Jan-2010, Greenup Lock, LRH, Huntington District), "nondestructive testing" of the MKARNS locks upper-anchorage assemblies was performed. The SWL testing revealed uncertain anomalies (perceived as crack indications) in 10-of-156 "LINK PINS" and SWD mandated "destructive testing" to obtain definitive information. Murray L&D (downstream, river wall, the single "link pin" of wedge-pin anchorage system that lies parallel to lock) was selected as the "destructive testing" location.	
2	**Removal/Replacement Procedure (incorporating Lessons Learned)**	
	description	NOTE(s)
2.1	prior to LOCK CLOSURE	1. issue Navigation Notice 2. advance notice 30-days minimum
2.1.1	replacement Link Pin: UT- inspection	to certify acceptable pin condition
2.1.2	replacement Link Pin: chamfer end	1. to depth of the keeper-plate slot 2. to ease insertion (into the link pin hole)
2.1.3	existing Link Pin: remove "top flange"	1. by machining w/hydraulic-milling machine 2. link pin & flange lip is hardened steel but machineable 3. do not assume flat or parallel surfaces
2.1.4	existing Link Pin: drill 1" pilot hole (NOTE no larger)	larger hole may require a Lock Closure
2.1.5	existing Link Pin: remove concrete below link pin	to allow link pin removal clearance
2.1.6	existing Link Pin: twisting or rotation (for removal ease)	1. "CONSIDERED UNNECESSARY" 2. cannot overcome friction and other residual loads
2.1.7	upper anchorage: install bracing & wedges (3-directions)	to prevent tension loads transmission into the existing miter gate anchorage
2.1.8	design/fabricate jacking frame	1. to work with above bracing & wedges 2. bracing shall remain in place during jacking 3. 100-ton press (min); if necessary
2.2	LOCK CLOSURE	per Navigation Notice
2.2.1	Miter Gate: maximum head	1. for d/s mg fill the lock chamber 2. for u/s mg drop the lock chamber
2.2.2	Miter Gate: weld contact blocks	at quoin & miter
2.2.3	existing Link Pin: remove existing link-pin keeper-plate	
2.2.4	existing Link Pin: drill 2" hole	1.use hydraulic-magnetic-mount drill press 2. for air-arc access
2.2.5	existing Link Pin: diamond-wire saw cut	1. one straight across cut (one push & one pull) 2. one more narrow pie-cut 3. CAUTION on the "bottom of the cut" do not damage (the bottom Gudgeon Link)
2.2.6	existing Link Pin: remove the narrow pie-cut	1. with air-arc 2. CAUTION do not damage (top/bottom Gudgeon Links &/or Anchor Arm)
2.2.7	existing Link Pin: remove	
2.2.8	Link Pin hole (in Gudgeon Links & Anchor Arm): clean-out	apply antiseize (to minimize galling)
2.2.9	replacement Link Pin: "shrink pin" in liquid Nitrogen	"expand hole" (Gudgeon Links & Anchor Arm assembly) by heating with a welding blanket heater
2.2.10	replacement Link Pin: install into Link Pin hole	
2.2.11	replacement Link Pin: slug to fit	1. until top flange touches the top Gudgeon Link 2. 100-ton press; if necessary
2.2.12	clean-up, clear-out, etc	return Miter Gate into service

Fabricate metal locking plates for hinges.

Weld contact blocks to secure position.

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Machining the head of the Link Pin to remove outer lip.

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Cutting groove through Link Pin head to attach pushing lever. Note previously drilled center hole.

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Pushing lever welded into place with horizontal bracing installed.

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Twisting pressure applied by hydraulic jacks.

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Jacking frame set in place.

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Jacking frame complete with 100 ton hydraulic jack.

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Link Pin frozen by application of liquid nitrogen thru center hole to induce shrinkage.

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With failure of pin to move under hydraulic jack pressure, diamond wire cutting was initiated.

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Diamond wire cutting complete. Diamond wire cut used to remove pin saving integrity of pin for further study and testing

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Pie-shaped section removed.

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Sledge hammer assisting Pin removal.

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Pin is out!

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New Pin, frozen with liquid nitrogen, ready to slot in place.

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New Pin in place.

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Old Pin showing band impressions and surface imperfections that led to false crack perceptions.

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Lessons Learned:

1. Ensure UT testing has data base comparison and or integrity of technicians are dependable.

2. “IF IT AINT BROKE….DON’T FIX IT!”

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